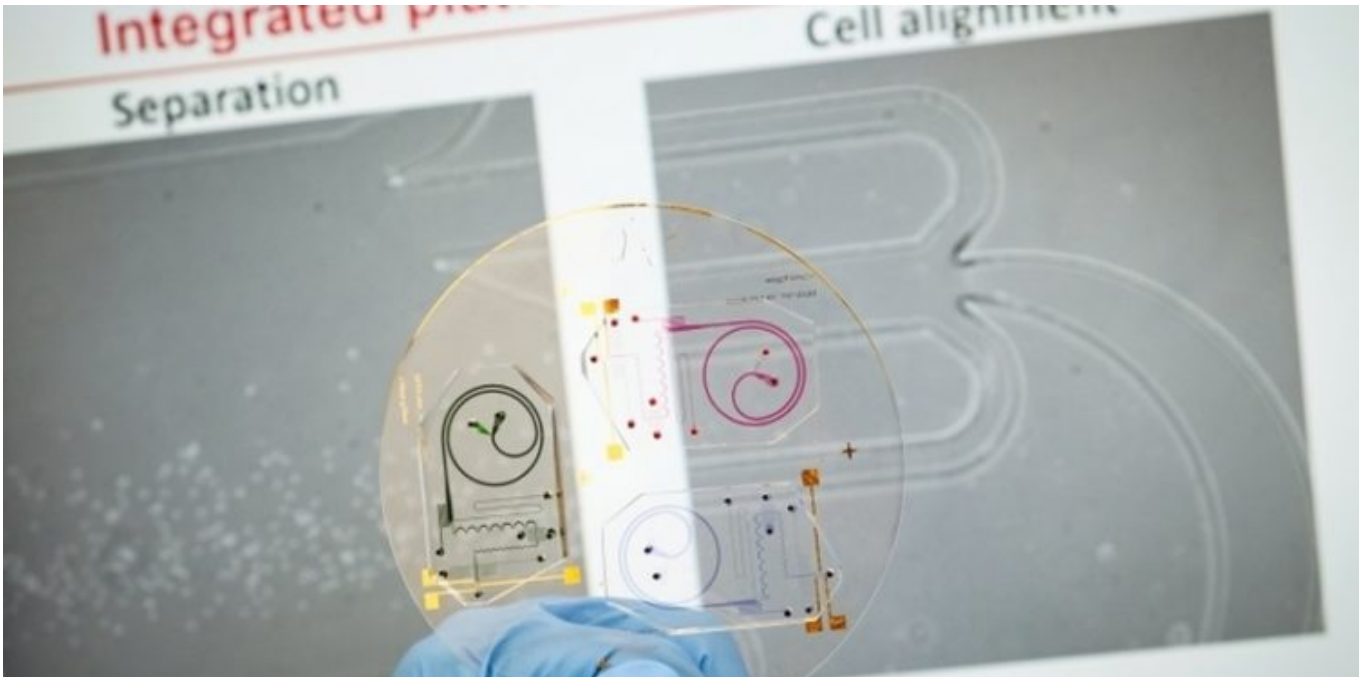
NTU researchers develop a new system for studying immune systems and white blood cells

The lab-on-a-chip system can detect the health features of an individual's immune system with just a drop of their blood.

by Shamini Priya — 27 September, 2019 in Digital Transformation, Healthcare, News, Singapore



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Scientists from the Nanyang Technological University of Singapore (NTU Singapore) have created a lab-on-a-chip system that can detect the health features of an individual's immune system. This can be done within minutes with just a drop of their blood.

The system employs a combination of microfluidics, which are tiny microscopic channels that can isolate white blood cells from blood, and electrical sensors to create the chips.

These chips will be able to identify the variations in the electrical properties of white blood cells which are collected from both healthy and diabetic patients.

This system was designed and developed by Assistant Professor Hou Han Wei, faculty member at the Lee Kong Chian School of Medicine at NTU and Assistant Professor Holden Li from the School of Mechanical and Aerospace Engineering.

Upon further successful laboratory and clinical assessments, this system could potentially be turned into a portable device for use in family clinics and polyclinics.

The device could in the future aid doctors to quickly obtain insights into a person's immune system and detect early signs of inflammation and infection that could indicate the need for more in-depth examinations of an individual.

Immune health is a sign of cardiovascular diseases. Scientists can potentially use the device as an additional screening tool for early detection of heart diseases. Cardiovascular diseases were the cause of about 30.1 per cent of all deaths in 2017 in Singapore.

Behind the system

The chip identifies electrical differences between one healthy and one unhealthy white blood cell.

Detection of abnormal white blood cells has been indicated to be early biomarkers for increased risk of cardiovascular diseases and indicate possible ongoing inflammation.

The chip physically separates the blood cells according to their sizes via tiny channels into the various outlets. These white blood cells are then put through a special channel where resistance to electric currents is measured for individual cells at high speeds of hundred cells per second.

“Our chips can isolate thousands of white blood cells from a single drop of blood and, within minutes, tell if these cells are electrically different from normal, which would be an indicator of whether there is a health issue to be further investigated,” Asst Prof Hou said.

He said that their method does not include the usage of chemical biomarkers or antibodies. In-depth analysis can be done the same white blood cells which have been run through the chip.

White blood cells are imperative to the immune system. Neutrophils, a certain type of white blood cell is the first border of defence that faces an infection or inflammation.

Abnormal cells usually have a higher level of resistance as compared to a healthy cell. This is because abnormal cells are bigger and have different membrane characteristics to that of a healthy cell.

This lab-on-a-chip system is also being explored in the use of studying NETosis. This is a recently discovered immune defence mechanism.

In the process of NETosis, neutrophils throws out DNA strands that contain bacteria and viruses and puts a hold to their movements. This in attempts to kill the bacteria and viruses.

Assistant Professor Christine Wong, from NTU’s Lee Kong Chian School of Medicine who is also a NETosis expert, said that the current process for studying NETosis is using real-time imaging or microscopy of fixed neutrophils.

These processes, however, require a lot of effort by researchers to separate individual neutrophils which could impact their native baseline state.

She said that this new lab-on-a-chip system could potentially allow for quick and accurate NETosis experiments and quantification.